Slovak Society of Chemical Engineering
Institute of Chemical and Environmental Engineering
Slovak University of Technology in Bratislava

PROCEEDINGS

51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA
Jasná, Demänovská Dolina, Slovakia
May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Valiyeva, K., Chávez Fuentes, J., Variny, M.: Modelling Material Flow in Wastewater Treatment Using Automated Methods, Editors: Mihaľ, M., In *51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025*, Jasná, Demänovská Dolina, Slovakia, 2025.

Modelling Material Flow in Wastewater Treatment Using Automated Methods

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With increasingly stringent environmental regulations, accurate material balance calculations in wastewater treatment systems are essential for identifying necessary process improvements in industrial enterprises. This study presents an automated tool for determining the material balance of wastewater, incorporating key parameters such as chemical oxygen demand (COD), biochemical oxygen demand (BOD), fluorine (F), and adsorbable organic halides (AOX). Wastewater treatment typically involves multiple stages, each with distinct processes. For modelling these stages, it is necessary to know the quantities and qualities of input and output streams. The developed program evaluates both theoretical purification indicators and actual cleaning efficiencies after each stage of treatment. This dual approach bridges the gap between theory and practice, enabling direct comparison of predicted and observed performance, which was one of the purposes of this work at the beginning. The program's primary advantage lies in its ability to track quantitative and qualitative changes in wastewater parameters across treatment stages, to compare theoretical and real purification efficiencies, and to predict final effluent quality, supporting data-driven decisions in water resource management. With this tool water treatment specialists and environmental engineers can assess the performance of existing treatment facilities or optimizing operational processes in industrial settings. Also, its use helps to mitigating environmental risks through improved wastewater management. By enhancing the accuracy of purification forecasts, this model contributes to more sustainable wastewater treatment practices, aligning industrial operations with evolving environmental standards.
The authors acknowledge the financial support from the Slovak Society of Chemical Engineering.